

XXI. *On the British (and a few Continental) species of Scoparia*, Hw. By T. A. CHAPMAN, M.D., F.Z.S.

[Read March 15, 1911.]

PLATES XXXV—XLIV.

THE suggestion to examine the British *Scoparias* came from Mr. E. R. Bankes. Though the opinions as to what are and are not distinct forms held by Mr. Bankes are, I believe, those accepted by the few other English entomologists that know the genus, and are practically identical with those I arrive at, they differ from those of any of the systematic works I have examined. The necessity for some such investigation as that here presented is therefore obvious.

Barrett ("Lepidoptera of the British Islands," 1904) differs from Meyrick (Handbook, 1895), who appears to be simply copied by Hampson (Trans. Ent. Soc., 1897). Staudinger (Cat., 1901) differs from all these, and seems to be simply copied by Spuler (Hofmann's "Schmetterlinge," 1910); nor do any of these agree with what appear to be the true facts. Barrett makes one species too many. Meyrick is certainly most in error as, with the greater pretensions to a scientific position, he lumps three species together, and has apparently led astray Hampson, Staudinger, and Spuler.

The different views held by all these authorities have reference almost entirely to the group indicated by the four names *basistrigalis*, *ambigualis*, *atomalis*, and *ulmella*.

In examining the male appendages to throw light on this matter, it was obvious that to examine these species alone was by no means sufficient; an examination must also be made of a number of other species so as to obtain some idea of what were specific characters of value. I therefore determined to examine all the British species and as many European species as could be readily obtained.

I do not think the Continental magazines show anything of importance on the question of the value of the specific distinctions claimed to exist between these four forms;

at any rate, I have not met with any. This is not, of course, surprising, considering that *ulmella* is not recorded out of England, and *basistrigalis* is nearly, if not really absolutely, in the same case. Our English magazines, on the other hand, have quite voluminous papers on the subject, to which I suppose I must make some reference, though it would be quite out of the question to transcribe them in full.

Knaggs certainly deserves the first place in connection with these species, having first described *basistrigalis* and *ulmella* (in E. M. M., iii, 1866, pp. 1 and 217). In 1869 he gave a *résumé* of the genus in the E. M. M., vol. v, p. 291. In this paper he makes nineteen species, of which five have since by general consent been sunk as varieties or local races of others: these are *zelleri*, *ingratella*, *phaeoleuca*, *gracilalis*, and *atomalis*. Two of these, *ingratella* and *phaeoleuca* are "good" species found on the Continent, but the supposed British representatives have been dropped as being varieties of other British species.

Hodgkinson has communications, amongst others E. M. M., vi (1869), p. 41; "Entomologist," xiv (1881), p. 223; E. M. M., xviii (1882), p. 134. He describes a new species, *conspicualis*, shown by Mason, E. M. M., xxiii (1877), p. 163, to be synonymous with *ulmella*.

A paper by Bower, E. M. M., xxxi (1895), p. 273, firmly establishes *basistrigalis* as a "good" species, as no one (Hampson excepted) seems to have disputed its position since.

Bankes, E. M. M., xxvi (1890), p. 7, clearly shows that *atomalis* and *ambigualis* are but one species, and mentions seeing drawings of the *genitalia* from Dr. Mason, but of these I find no other record. There are other communications by Briggs, Porritt, and Tutt.* In 1900 Knaggs has in the "Entomologist" (xxxiii, p. 109) an able paper on this group (*ambigualis*, etc.). He produces many reasons for retaining *atomalis* as distinct from *ambigualis*. In Staudinger's list, published just after, *basistrigalis* is admitted, but *atomalis* and *ulmella* are sunk under *ambigualis*; possibly the *ulmella* was disallowed under a doubt raised by Dr. Knaggs's plea for *atomalis* being unsound,

* Other references are: Briggs, "Entomologist," vol. xxii (1890), p. 17; E. M. M., vol. xxvi (1890), pp. 50, 124; Tutt, E. M. M., xxiv (1887), p. 43; E. M. M., xxvi (1890), p. 51; Porritt, E. M. M., xxvi (1890), p. 88.

weakening the little he said about *ulmella*. Barrett, later (1904), followed Knaggs, and Spuler (1910) followed Staudinger.

An examination of the genitalia confirms the conclusion arrived at by Bankes, Bower, etc., and shows the high authorities above quoted to be in error.

The British *Scoparias* appear to divide themselves into two groups. Bionomically these are (1) those whose larvae are more or less known to feed on mosses and lichens; (2) those whose larvae are for the most part unknown, but probably, from the analogy of *S. cembrae*, the only one of the group certainly known, feed on the root stocks of flowering plants, and most likely of compositae. These two groups may also be defined by the male appendages, the latter group possess very large and obvious darts (*cornuti*) on the eversible membrane (*vesica*, Pierce) of the *aedocagus*, the former (the moss-feeders) are quite without them. That they possess other obvious characters to distinguish them is proved by the fact that nearly all accounts of the genus place the root-feeders (if so) together, at the beginning, with the moss-feeders following, or *vice-versâ*.

The British species that belong to the root-feeders are—

cembrae.

basistrigalis.

ambigualis (*atomalis*).

ulmella.

dubitalis (*ingratella*).

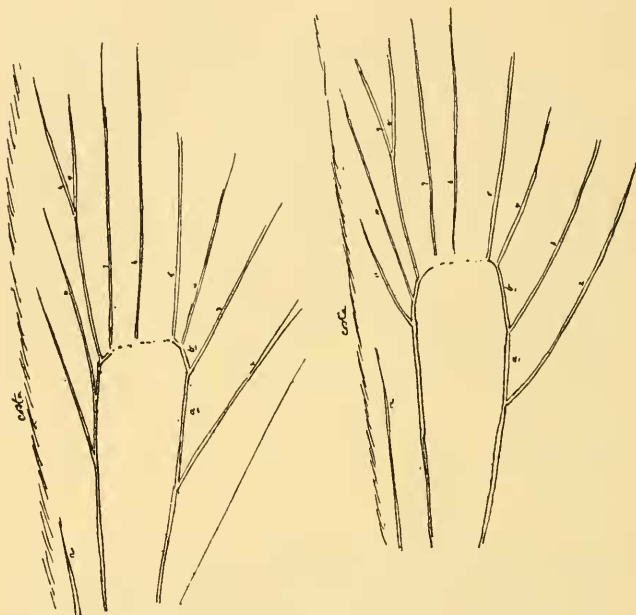
The remaining nine are the moss-feeders.

The root-feeders may be defined—

1st. As root-feeders. This is a definition founded not on knowledge, but on ignorance, and so may seem open to objection and even ridicule. It takes, however, a positive and unobjectionable form, if we say, had they been moss-feeders we should have ascertained it, therefore they must feed on something else; that that something else is roots is, of course, a guess founded on our knowledge of one (or possibly two) species only.

2nd. There is a decided difference in wing form. The ends of the fore-wings are more square in the root-feeders, more oblique, *i. e.* with more pointed apex in the moss-feeders. There is a little corresponding difference in neuration. In the moss-feeders the portion of cell margin between veins 3 and 4 of the fore-wing is shorter, and

takes a bend at vein 3, in excess of what it does in the moss-feeders. In this respect *pallida* agrees with the moss-feeders, but it disagrees in a character to which Knaggs called attention in 1869 (E. M. M., p. 291), viz. the relation of the orbicular and claviform stigmata to the first line. In the root-feeders these stigmata touch the line; in the moss-feeders, one or both are free from it. By this character *pallida* should be a root-feeder.



A. *Scoparia dubitalis*.
B. *Eudoria sudetica*.

Camera sketch of neuration of fore-wing, characteristic of "root-feeders" (*Scoparia*) and "moss-feeders" (*Eudoria*). Note relative lengths of *a* and *b* in the two species.

3rd. The male appendages in the root-feeders have conspicuous darts (cornuti) in the aedeagus; the claspers have at their ventral basal aspect a thickened portion, ending at half the length of the clasp in a free spine (Harpe), and the uncus is tapering, sharp, and simple.

In the moss-feeders there are no cornuti, no spine on the margin of the clasp, and the end of the uncus is blunt, almost double, due to the arch underneath coming close to the tip, instead of arching across some way from the end.

By this 3rd character *pallida* is a moss-feeder. It is the only British species that is not by these 2nd and 3rd set of characters distinctly of one group or the other.

There is a difference in the ♀ genitalia in at least one point between *Scoparia* (root-feeders) and *Eudoria* (moss-feeders). In *Eudoria* there is a small area quite entitled to be called the *lamina dentata*, as here the angular chitinous points are packed closely together and are well developed, being over the rest of the sac hardly present. In *Scoparia* they are very little more developed at one point than another, but more developed than they are in the unspecialised area in *Eudoria*. Still, there are several species that do not show this difference in at all a marked manner.

I present photographs of the terminal segments of the females of most of the species dealt with, and also of the Bursae.

I cannot define the genera on characters from these structures, perhaps because I have not studied them enough. There is a tendency, however, in the moss-feeders to agree in having a somewhat spherical bursa, with a patch of spicules, and to have a structureless spherical cavity beyond the bursa. In the root-feeders the tendency is to have this tract less markedly divided into spherical cavities; the bursa is a widened portion of the tube, with spicules well distributed, but more developed on either side, and there may be a not dissimilarly armed area nearer the lower end of the tube, whilst the upper unarmed termination is not separated from the bursa by a very marked constriction. But individual species are sufficiently exceptional to prevent any definite rule appearing. It is also certainly the case that the last segments, by their form and the length of the rods, show much greater extensibility in the moss-feeders than in the root-feeders, implying that the former place their eggs more deeply than the latter do.

There is another character that is very variable between the different species in the relations of veins 7 and 8 of the hind-wings. The anastomosis of these obtains in so many genera of Pyrales, that one hardly expects it to be so very variable in amount in one genus. In *basistrigalis* they do not really anastomose, but only touch for about 0.3 mm. In *alpina* they are coincident for about 1 mm., but I do not find that this difference obtains in a way to distinguish the moss-feeders from the root-feeders, since it

is, for example, a short anastomosis in *sudetica* and long in *ingratella*.

There are, however, two species that do not quite fall in with these simple divisions. These are *crataegella* and *pallida*, and of European species, *centuriella* and *pyrenacalis* equally occupy distinct and isolated positions.

Of the various authorities I have so far referred to, beyond placing the root-feeders and moss-feeders more or less together, none give any indications of the natural affinities of the species and consequent divisions of the genus.

To find anything of this sort we have to go back to Guenée (1854). With the exception of *pyrenacalis* and *crataegella*, he distinguishes each of the divisions that I find in fact to exist, and even *pyrenacalis*, though not separated, is placed at the top of its division as not quite according with the others. *Crataegella* thus forms the only new section that I recognise, and I certainly was somewhat surprised to find the genitalia gave it so definite a position, as I fully sympathised with those entomologists who found it difficult to separate it from *frequentella* (*mcCreurella*), although the distinguishing markings though small, are very definite.

Stephens (Illust. Haust. iv) and Zeller (Linn. Ent., i, p. 262) afford no assistance in showing the mutual relationship of the species.

Ochrealis ought to be referred to, it is really not a *Scoparia*. Neither the clasp, the uncus or the tenth sternite are at all like those of any other species, and the cornuti contained in the aedoeagus are 50 or 60 in number, short acute spines, ranged 3 or 4 wide along the whole length, not altogether unlike, say, *Acronycta tridens*, but with no resemblance whatever to any *Scoparia*.

Guenée gave this a separate genus, *Cholius*, in which he was quite right, but probably, as he says, wrong in placing it in *Crambina*, but also wrong in replacing it in *Scoparia*. The real place seems to be somewhere in *Pyraustinae*. It may or may not be the nearest pyraustid to *Scoparia*, but it is not very near.

Putting *ochrealis* aside, all the other species I have examined are certainly tolerably closely related, but admit of being easily divided into groups, which may be called genera or subgenera.

The divisions are practically those instituted by Guenée. He did not give them names, and this may account for

later, but obviously less scientific authorities neglecting them. To such distinctions as appealed to Guenée, I add the definite structural points afforded by the genitalia, and supply them with names which will be useful in any future discussions of the group.

I classify as follows—

- PYRAUSTINAE ?

CHOLIUS, Gn. (Ind. Micr. p. 95) Group IV, Guenée.
ochrealis, Schiff.

SCOPARIINAE.

1. SCOPARONA (Augm^o of Scoparia). Guenée, Group I.
centuriella, Schiff.
2. SCOPARIA, Hw. Guenée, Group II. † and ††.
Dubitalis, Hb.
(*ingratella*, Z.)
ambiguus, Tr.
(*atomalis*, Dblid.)
gallica, Peyer.
manifestella, Hs.
ulmella, Kg.
cembrae, Hw.
basistrigalis, Kg.
phaeoleuca, Z.
perplexella, Z.
3. ANARPIA (*α ἀρπη*). Included by Guenée in Group II †.
pyrenaealis, Dup.
4. WITLESIA (Whittlesea syncopated). Group III, Guenée.
pallida, Stph.
5. DIPLEURINA (*δὶς πλευρα*). Included in Guenée's Group II †††.
crataegella, Hb.
6. EUDORIA (mutation of *Eudorea*). Group II †††, Guenée.
murana, Curt. (type).
truncicolella, Stt.
suletica, Z.
(*petrophila*, Stndf.).
frequentella, Stt. (*mercurella*).
alpina, Stt.
valesialis, Dup.
angustea, Stph.
lineola, Curt.
resinea, Hw.
laetella, Z.

2 are the typical "root-feeders," 6 the moss-feeders.

It may be convenient before treating the species in order, to consider first those as to which I have anything definite to say as to specific separation or otherwise of forms, as a result of studying the appendages.

In 1867 Knaggs introduced *ingratella* as a British species (E. M. M., iv, p. 61, 1867), but this was afterwards abandoned on the ground that Knaggs's specimens were only varieties of *dubitalis*.

When we examine the appendages we find those of *dubitalis* and *ingratella* quite identical, except as to size, *dubitalis* being the smaller. The cornuti are placed in a row, are five or six in number, the most forward (whilst still within aedoeagus) the larger, the rest dwindling regularly. When we get a side view of them this is very obvious, but if they happen to be superposed, it is at first difficult to see that they are not one long rod, until the several bases are discerned, the tips being in this position quite obscured.

If there is no difference here what is the difference otherwise? It is an almost inappreciable one of size. *Dubitalis* has an expanse of 18 mm. up to 22 mm.; *ingratella* 20 mm. to 23 mm. My specimens of the latter are some sent by Zeller to Barrett, some received from Staudinger are identical, so that I believe I have the true *ingratella*. *Dubitalis* var. *ingratella* from Mr. Bankes is very like those I have as *ingratella*. The chief differences I can see consist in the claviform stigma being more usually open in *dubitalis*, closed, *i. e.* without a distinct pale centre, in *ingratella*.

Dubitalis has a paler whiter colour, and the markings are more distinct; *ingratella* is of a warmer yellower tint, and the markings are pale; it exaggerates, but marks the difference, to say that *dubitalis* has some of the markings black, in *ingratella* they are merely an accentuation of the ground colour. But specimens that are taken with *dubitalis*, and are, I presume, undoubtedly *dubitalis*, including English *ingratella*, vary in the same directions and are in fact indistinguishable from *ingratella*. I conclude that *ingratella* is a larger, paler as regards markings, richer as regards ground colour, form of *dubitalis*, a southern form, if not absolutely geographically, at least as regards summer temperature.

Ambigualis and *atomalis* might be dealt with as being closely parallel to *dubitalis* and *ingratella*. They need

also less discussion as the consensus of opinion is now that they are one species, a consensus that in the case of *dubitalis* only refers to English *ingratella*, the result probably of English acumen applied to this point, and not to whether English and Continental *ingratella* were identical.

The appendages of *ambigualis* and *atomalis* are identical except again that those of *ambigualis* are altogether larger, quite distinctly so in typical instances, viz. as 12 to 11. In *ambigualis* we have a southern larger and paler, in *atomalis* a northern smaller and darker form. I should say that the extreme forms were much more nearly distinct species, than were any forms of *dubitalis* and *ingratella*.

Two other forms, *manifestella* and *ulmella*, have appendages that I cannot distinguish except in size. Though I have no hesitation in saying that in a certain broad sense these two forms are one species, they are nevertheless vastly more distinct from each other than is *ingratella* from *dubitalis* or *atomalis* from *ambigualis*. Their habitats are widely separated. I know of no intermediate forms. The difference in size is very great, 26 mm. and 17 mm., and there is one really important difference in marking, viz. the orbicular stigma is usually separate from the first line in *manifestella*, never I think in *ulmella*.

They are, again, a northern and southern form whose differences have been exaggerated by long segregation, so that for all practical purposes they must be treated as distinct species.

The male appendages of these two forms appear to be quite identical except in one point: those of *manifestella* are about 10 per cent. larger than those of *ulmella*. There is a very similar difference in size in the moths so far as my examples show, though I believe some of my *manifestella* are rather large specimens. Are we to regard these two forms as one species or as two? I think the usual custom in such cases is to regard them as one species. They are, no doubt, very marked geographical races, that have not been syngamies for a long period, but, on the other hand, they can have separated really only yesterday, so to speak, in comparison with the period, whatever it may be, necessary to differentiate unquestionable species.

Though the question may thus be raised as to whether *ulmella* should not be regarded as a race of *manifestella*, its differences from *ambigualis* are very great, though

various authorities who ought to have known better have confounded them.

Basistrigalis is very distinct from any other species.

There are two other forms that seem to be very probably really only forms of one species. These are *sudetica* and *petrophila*. *Petrophila* is the smaller and darker, yet it can hardly be called either a more northern or more alpine form. I take it, however, to be a local race of the more wide-spread *sudetica*, the appendages are identical.

I add a few notes on the appendages of each species that will make the photographs of them more easily understood as to the points of specific distinction they possess.

I have to regret that I have not mastered any satisfactory way of spreading these appendages for observation. They are rather awkward and obstinate, and at the same time small and delicate, so that one has to accept a poor result rather than persevere at the risk of considerable damage to the specimen.

Centuriella (figs. 2-5) has large dense appendages. The aedocagus is rather narrow, there are no cornuti, the uncus is not tapering as in the other species, but has nearly parallel sides narrowing only a little to a broad blunt tip. The tenth sternite* also thicker before the apex, and on its upper surface has some minute rough teeth; the large clasps have some not very definite basal thickening, they also have a spine about the middle of the ventral margin, but this springs from quite a soft margin of the clasp, it is short and blunt, and is free from hairs only in a short terminal portion.

The question as to whether *ambigualis* and *atomalis* (figs. 8, 10, 11, 12, 13) are distinct species seems to be fairly settled in the negative without reference to the appendages. So far as structure goes these also appear to be quite identical. I found one or two typical specimens of each form differed quite decidedly in size, but before undertaking to consider how far this suggested distinct species, local races, or what not, I thought it best to measure some specimens without reference as to which species they might belong, this partly because I could

* I propose to point out elsewhere that this is usually called the *scaphium*; it is, however, subanal, but is not the sub-scaphium of Pierce. The scaphium of Gosse is supra-anal. Pierce is the only authority who seems to have understood this.

not always decide which the specimen before me really was. I measured from the base of the clasp to the end of its lateral spine, and also the total length of the clasp.

The result comes out that in ten specimens measured, the length from the base to the end of the spine shows 0·87, 0·90, 0·93, 0·93, 0·93, 0·96, 0·96, 0·96, 0·99, 1·05 mm. The total lengths are 1·23, 1·24, 1·26, 1·29, 1·30, 1·35, 1·35, 1·37, 1·41, 1·47 mm. These figures show that, though the smallest are *atomalis* and the larger *ambigualis*, there is no point at which a line can be drawn to separate them as of different sizes, since as a matter of fact the two series overlap.

Cembrae (figs. 24–27) may be taken as a type of the root-feeders. The clasps have the basi-ventral thicker portion large, and the hook or spine in which it ends is two-thirds the length of the side of the clasp from the base. It is strong and curved well away from the clasp, so that its point is in a line nearly transverse to the length of the clasp.

The dorsal armature consists of an uncus, which may be perhaps more easily described by likening it to the toe, or rather the front three-quarters of a slipper, but with sole and upper in one continuous piece. The sole is on the dorsal aspect, the sides are narrow, the apex is prolonged to a point, and the two sides meet about two-fifths of the total length from the point, the surface has various long hairs. In the base of the uncus is hinged a piece that must be called the tenth sternite. When closed against the uncus it is of about the same length. It is a straight piece tapering to a curved point, and basally divides into two branches widely separated, and it is by the ends of these that it is hinged to the base of the uncus. The arch formed by these two branches below and the cavity of the "slipper" above give space to the anus.

The aedoeagus is broad and short, 1 mm. long, or perhaps less, as a terminal ring seems to be possibly everted membrane, and nearly 0·3 mm. wide. It contains two groups of cornuti. In one of these the separate spines are so much soldered together that the mass might almost be regarded as one spine. In the other they are closely connected, but are partially separate, the largest one about 0·4 mm. long.

It is to be noted that the uncus is soft membrane carrying hairs, and is easily deformed in preparation and

mounting, the tenth sternite is of hard smooth chitin without hairs, and a very strong definite mark or fracture is seen if it be damaged.

In *basistrigalis* (figs. 19–23) the uncus and tenth sternite are very like those of *cembrae*. The basal arch of the tenth sternite is narrower, and the branches enclosing it therefore shorter, but the long spike of which it mainly consists is rather longer (total length about 0.6 mm.).

The thickened upper margin of the clasp is more marked, and extends nearer to the end of the clasp. The lower marginal thickening is, however, much smaller, and its terminal spine lies almost parallel to the margin of the clasp. The result is that the smooth, soft portion of the clasp looks larger.

The aedoeagus is fractionally longer and narrower than in *cembrae*. The cornuti as seen within it are in two rows, those in each row partially united at their bases, the longer spines nearer the opening (a little over 0.25 mm. long), and those of one group stronger but fewer than in the other.

In *ambigualis* (figs. 8, 10, 11, 12, 13) (*atomalis* is identical) the uncus is narrower and shorter, as also the tenth sternite (about 0.4 mm. long). The bridge is narrower and the two branches are less spreading, the margin of the long spine continuing down to the hinge in one smooth sweep, without any bend as in *cembrae* and *basistrigalis*. The thickened dorsal margin of the clasp is very definitely outlined. The basi-ventral thickening is intermediate between those two species, and the terminal spine is at an angle of about 45° to the margin of the clasp. Aedoeagus is a full millimetre long and about .25 wide. The cornuti are in a group of two rather long (0.25 mm.) and strong, a third smaller, and three or four others diminishing so that the smallest is hardly visible.

In *manifestella* (and *ulmella*) (figs. 14–18, 72) the cornuti of unknown number are fused together into one solid and rather thick mass, not unlike in form and appearance to the horn of a rhinoceros. The aedoeagus is short and broad, a characteristic of “root-feeders.” The spines of the clasps are strong and sharp, and leave the clasp at about the middle of the lower margin.

In *gallica* (figs. 39, 73, 74) the spines on the clasps are rather sharply hooked at the tips, and as compared with nearly all the other species they are thick and straight, with

the hook quite at the tips, instead of having a regular curve and a gradual taper throughout. The cornuti are five or six in number, not very unlike those of *dubitalis* but larger and stronger. The resemblance to *dubitalis* is considerable, but the size is to that of *dubitalis* as 4 to 3, and the general appearance and texture is of at least corresponding density and robustness.

Phaeoleuca (figs. 28–30) much resembles *ingratella* (figs. 7 and 40) in having the cornuti very long, straight and slender, two long ones and one or two shorter often apparently only two, but the shorter are so closely adpressed to the longer that one suspects their existence as they cannot easily be made out. In *ingratella* these cornuti are much shorter and less robust than in *phaeoleuca*, being about 0.55 mm. long, whilst in *phaeoleuca* they are about 0.8 mm. and much denser and stronger.

Some specimens from Staudinger, sent as *ambigualis*, var. *syriaca*, are indistinguishable from *phaeoleuca* (assuming that I have the latter species correctly named)—at first I took them for *ingratella*. In any case they are certainly not *ambigualis* in any form.

In *perplexella* (figs. 31–32, 69, 71) the appendages are very large, equal in size to those of *centuriella*. The species is itself a large one. Unlike *centuriella* it is a typical *Scoparia*, nearer, perhaps, to *dubitalis* than to any of the others.

Pyrenacalis (figs. 33–35) (with *crataegella*, though quite differently) has some characters making it intermediate between the root- and moss-feeders. It belongs rather to the root-feeders as having well-developed cornuti. These are long and slender, like those of *phaeoleuca* or *manifestella*, but differ in being not straight but curved. The clasps, however, are those of the moss-feeder group in having no side spine or corresponding thickened basal portion.

The specimen of *incertalis* I have is *pyrenacalis*.

Crataegella (figs. 41–43) is a moss-feeder in fact, and as regards the appendages also, in possessing no cornuti. The aedoeagus is rather curved, and less slender than in most moss-feeders. It has a root-feeder character in a modified form, viz. the clasps have the basi-ventral thickening, but this is narrower than in the connected species, and stretching further along the margin of the clasp, ends, not in a spine, but in a rounded thickening that is only just free at its end from the body of the clasp. In mounting this clasp it was found to differ from both

the sections in having a dense margin above and below, and always tending to fold in the intermediate softer portion, so as to be very troublesome to spread, in a way different from either of the other sets.

This very distinctive structure of the appendages shows that it is wholly unrelated to *frequentella* (*mercurella*).

In the moss-feeders there is difficulty in finding any striking characters to distinguish the several species, such as are afforded by the cornuti of the root-feeders. There are, before going into specific detail, to be noted two structures (or parts of one) that are present in all these, but one of which is apparently wanting in the root-feeders, or if present is in a rudimentary and inconspicuous condition. These would appear to be details of the penis-sheath, *i. e.* of the floor of the cavity in the region where the aedoeagus pierces it. One is a thin flat plate of chitin, of somewhat pear-shaped outline, the rounded end attached between the bases of the clasps and the narrow end close to the aedoeagus and with the rest of the floor attached to it, and is dragged when the aedoeagus is forcibly displaced. (This can be seen in the root-feeders.) The other consists of two small rounded eminences, one in either side, carrying a few hairs.

As a rule, both insects and appendages are smaller than in *Scoparia*.

Pallida (figs. 36-38, 67) has the tenth sternite broad and flat, hardly divided into an arch at base, and a long narrow body. The neck is half-way up, the body is comparatively broad, so that it is more nearly a flat triangle than the arch below and the rod-like body above, as in most species.

Alpina (fig. 57) may be distinguished from the other species under review by the character of the tenth sternite, which has spreading wings forming the arch, but the column is broad and thick, the end blunt and roughened by minute points; the division between the basal wings runs as a suture an unusual distance up the broad column. The dorsum of the ninth segment is conspicuous as a triangular well-chitinised piece.

Resinea (fig. 65), unlike *alpina*, has the wings of the tenth sternite forming a very low and flat arch, and the body, rising from them already narrow and as a thin pillar, tapers almost to a point. No other species has the pillar or body of the tenth sternite so slender and tapering.

There are further eight species (of which five are British)

of moss-feeders, whose appendages are very much alike. Of these *angustea* (figs. 59–60) is at once distinguishable by the shortness of the aedoeagus (about 0·78 mm.), about three-quarters that of any of the others, which, however, vary a little.

Frequentella (mercurella) (figs. 54–56) has a very definite bend in the aedoeagus much like *sudetica*.

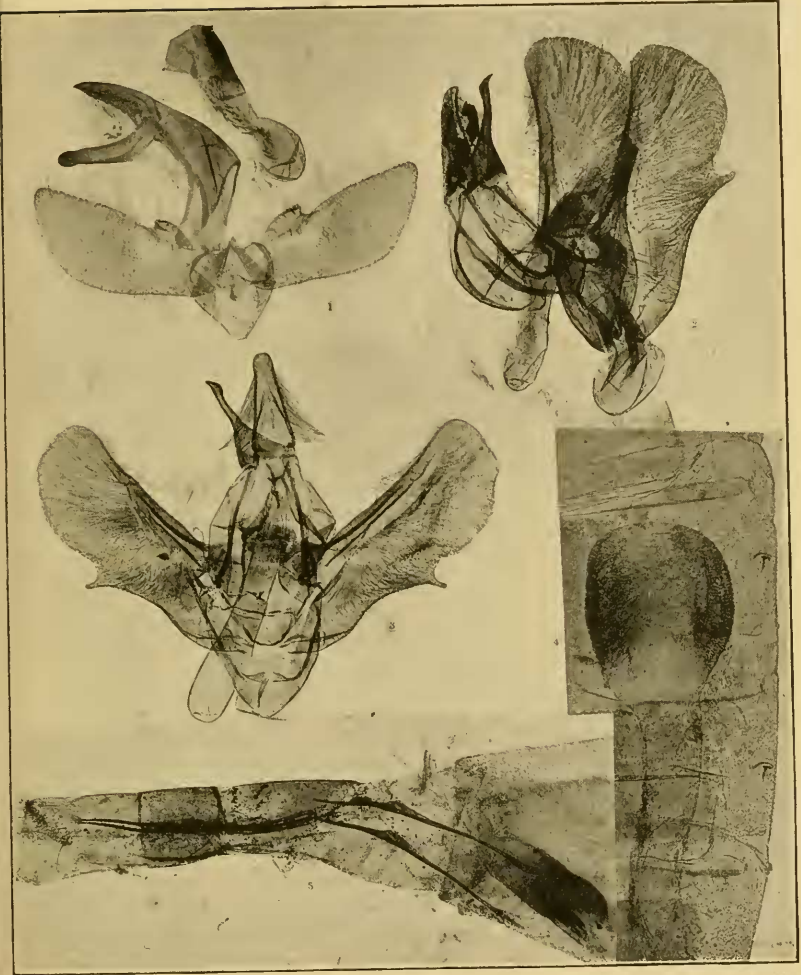
Frequentella and *sudetica* (figs. 50–53) have the tenth sternite with a very low base and arch and a long, straight, rather slender shaft, with an almost bulbous tip in *frequentella* present but not so pronounced in *sudetica*. *Sudetica* has the opening of the “slipper” (of the uncus) extending nearly to the tip, in *frequentella* it arches over only about one-third from the base, *i. e.* high up in the instep.

Valesialis (fig. 58) is larger than any other of the moss-feeders, the clasps being 1·2 mm. long against less than 1·00 for any of the others. The chitin is denser and darker. The aedoeagus, however, is small by comparison, *i. e.* about the same length as the others (1·00 mm.) but narrow, *viz.* 0·13 mm. The uncus is very similar to that of *lineola*.

In *laetalis* (figs. 64, 66, 70) the blunt end of the uncus characteristic of the moss-feeders is broader and more distinctly notched in the middle than in any of the other species. The tenth sternite is about equally divided in length between the shaft and the basal arch, the shaft is of about uniform, rather narrow, width for its whole length, and the base spreads almost suddenly, with straight lateral margin from its lower end.

Lineola (figs. 61–63) differs from any other member of this division (except *laetalis*) in having the clasps much narrower than in them just beyond the dorsal margin of its attachment, agreeing in this very nearly with *laetalis* and *pallida*, *e. g.* in *lineola* the width at this point is 0·2 mm. and 0·33 at the widest point. In *truncicolella* the relative widths are 0·27 and 0·33, and in *laetalis* 0·20 and 0·27 mm. The aedoeagus has a slight S bend and is rather broad (0·17 mm.), broader than any other except *truncicolella*, a fact the more conspicuous as the appendages as a whole are rather small.

Murana (figs. 44–46) has a slightly shorter aedoeagus than the other species (except *angustea*) of this group (barely under 1·00 mm.). The uncus is at once distinguishable as having the opening of the “slipper” very square, so that the two sides are of about equal width up to the



A. E. Tonge, photo.

C. Hentschel.

CHOLIUS, SCOPARONA.

